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ABSTRACT

A study assessed the impact of elementary-level bilingual programs on the academic achievement of 1,200 Mexican-American high school sophomores. Language and educational background factors, such as participation in various types of bilingual education programs, were analyzed and correlated with later educational achievement, while controlling for socioeconomic status, home language, type of bilingual education program, sex of respondent, and other variables. Hierarchical component analysis was developed to assess the long-term impact of various components of bilingual education programs: (1) English as a Second Language (ESL); (2) the teaching of reading and writing in Spanish; (3) other subjects taught in Spanish; and (4) the teaching of ancestral/cultural history. Results indicate that the addition of an ESL component to a bilingual program was associated with mixed effects on long-term achievement. Instruction in reading and writing in Spanish had a positive effect on achievement while the teaching of other subjects in Spanish was clearly associated with a lowering of test scores. The teaching of ancestral/cultural history yielded a positive impact when added to bilingual education programs. (DJD)

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Long-Term Effects of Bilingual Education on a National Sample of Mexican-American Sophomores: A Component Analysis*

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Abstract

In 1980, the National Center for Education Statistics sampled approximately 30,000 sophomores and 28,000 seniors in the United States, forming the base year set of the "High School and Beyond" longitudinal study. "High School and Beyond" contains the most detailed information on language use and respondents' educational history currently available, in addition to complete transcript files and achievement data, making it well suited to the study of the long-term impact of bilingual education.

The purpose of this study was to assess the impact of elementary-level bilingual programs on the academic achievement of a cohort of 1,200 Mexican-American sophomores. Language and educational background factors, such as participation in various types of bilingual education programs were analyzed and correlated with later educational achievement, while controlling for socioeconomic status, home language, type of bilingual education program, sex of the respondent and other background variables. Academic achievement was measured through three "High School and Beyond", standardized test scores: English comprehension, vocabulary, and mathematics, universally administered to the sophomore cohort.

The statistical design of "High School and Beyond" employs a two-stage, stratified probability sample. Schools were drawn from a national pool with a probability proportional to their size.

Hierarchical component analysis was developed to assess the long-term impact of various components of bilingual education programs: ESL, reading and writing in Spanish, other subjects taught in Spanish, and ancestral/cultural history. This analysis makes it possible to meaningfully compare differing types of bilingual programs, while controlling for socioeconomic status and other background factors.

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I. Introduction

Bilingual-bicultural education is a comprehensive approach to education which involves the solid development of English language skills and skills in the child's native language. It is defined as academic instruction in two languages and should include consideration of the cultural or ancestral history of the students. Students should attain good academic achievement in all subject areas (Andersson and Boyer, 1970).

Diverse program characteristics pose a major problem in assessing the effects of bilingual education. Zirkel (1972) found that some programs labeled "bilingual" were barely different from classes not labeled bilingual. In general, however, emergent

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programs came to contain one or more of the following components: English as a second language (ESL), instruction in reading and writing in the child's first language, other content areas such as mathematics and science taught in the mother tongue and instruction about the cultural or ancestral history of the student.

Research on the academic effects of bilingual education programs has produced mixed and contradictory results (Swain, 1979). There has been no global plan for program evaluation; neither has there been an assessment of program variation (Willig, 1985, p. 273).

Walker de Félix et al. (1985, p.1) state some of the difficulties encountered by researchers in program evaluation:

1. Most districts keep no files on students participating in bilingual programs.
2. Districts are hesitant to let researchers have access to achievement data.
3. Students who are taught content areas in their native language may not demonstrate that achievement when it is measures in English.
4. Districts rarely keep program descriptions and moreover can rarely document that the program was implemented as intended.
5. Evaluators fail to document the social forces that have influenced the program throughout the year.

It becomes apparent that such confounding factors make the assessment of bilingual programs difficult. Debates on the merits of bilingual programs have gone on from even before the passage of the Bilingual Education Act in 1968. In addition, political considerations may be partially responsible for societal attitudes toward bilingual education programs.

Navarro (1983) found that bilingual education has a positive impact on bilingual education students, their families, and their communities. Stanisfield and Hansen (1979) produced results which indicate that bilingual education promotes a positive attitude toward school. A positive attitude should lead to lower absenteeism and lower drop-out rates.

Takesian (1967) postulates that the dropout problem has its roots in elementary school. Within that context, the potential dropout learns for the first time that he or she is somehow "different". Students in the elementary school grades develop a negative attitude toward school when encountered with repeated frustration and failure. It is within this context of lowered esteem and self-doubt that the student psychologically leaves the classroom. Later, when he is chronologically old enough to do so, the student may leave physically.

Well-designed bilingual programs adhere to sound educational principles by building on the knowledge base of the child and starting the child where he or she is. Evidence indicates that bilingual education may play a major role in lowering dropout rates (Curiel and Richek, 1985).

Although program evaluations of bilingual education contain conflicting results, it may be safely concluded that bilingualism, per se, does not retard children's language development and achievement and has been shown to have positive effects (Cummins, 1981; Barklay, 1983; Saldate, Mishra & Medina 1985; Lebya, 1978; Curiel, 1979). Concerning the efficacy of bilingual education, Willig (1985) notes that the differences in research conclusions are underscored by the fact that in each serious attempt to review the research evidence, the majority of studies are rejected on methodological grounds (Baker & de Kanter, 1981; Dulay & Burt, 1978; Engle, 1975; Troike, 1978). Further, some studies accepted as methodologically adequate by one researcher were rejected as inadequate by other researchers. The fact that Troike (1978) found only 7 of 150 research and evaluation reports to be methodologically adequate, Dulay and Burt (1978) found only 12 of 180 studies acceptable, and Baker and de Kanter (1981) found only 28 of 300 studies methodologically sound highlights the need for a serious reappraisal of models used for program evaluation. Major reasons for rejecting research studies were found in research design, incomplete documentation or description of programs under study, statistical

procedures used in evaluation, and lack of control for background factors such as socioeconomic status and language proficiency.

The present study grew as an attempt to clarify possible reasons for conflicting research results. In addition, it addresses the need to take a global look at and categorize the diverse bilingual education programs which emerged during the late 1960's and 1970's in the United States and assess their effectiveness. A method of analysis which takes into account differing internal components of bilingual education programs will be described in the following sections. Bilingual education programs may then be compared and contrasted to see if patterns of long-term academic success develop from specific program components or designs. Secondary data analysis was performed on the High School and Beyond data base. This data base was developed from a national sample of high school students in the United States.

II. The High School and Beyond Data Base

Recognizing the need for global samples for the study of diverse educational issues, the National Center for Education Statistics developed an extensive data base. This data base, called High School and Beyond (HS&B), provides data on approximately 30,000 sophomores and 28,000 seniors in the United States. The first set of data was gathered in 1980 and a subsample of this group will be followed longitudinally through 1990. A particular strength of this data base lies in the extensive student background variables available for analysis and the inclusion of a detailed language file which provides information on language background factors and participation in bilingual education programs. According to So (1982, p. 6), this data base is of particular importance to researchers in the field of bilingual education because of its excellent language file. Nielsen and Fernández (1981, p.3) further attest to the usefulness and high quality of the HS&B language questionnaire.

The language file from HS&B distinguishes the status of childhood language from present language usage patterns, enabling researchers to study patterns of language shift in language minority students across more than a decade. Additionally, the language file distinguishes language usage patterns both within and outside the home. Distinctions are also made between oral proficiency (listening and speaking) and literacy (reading and writing). Most importantly for this study, the language file contains information on background experiences with elementary school bilingual education programs. Information is available in the following areas: English as a second language (ESL), reading and writing in Spanish, other subjects taught in Spanish, and ancestral/cultural history. This information allows the researcher to differentiate among and classify differing types of bilingual education programs. When merged with the student file, social background variables and academic achievement variables may be investigated. The role of bilingual education on long-term student academic achievement may be thus analyzed.

The following is a description of the Base Year sample design, as reported in the High School and Beyond 1980 Sophomore Cohort First Follow-Up Data File User's Manual (Jones et al., 1983).

A Brief Description of the Base Year (pp 2-4)

> The Base Year survey was conducted in the spring of 1980. The study design included a highly stratified national probability sample of over 1,100 secondary schools as the first stage units of selection. In the second stage, 36 seniors and 36 sophomores were selected per school. (In schools with fewer than 36 in either of these groups, all eligible students were included.) . . . . Over 30,000 sophomores and 28,000 seniors enrolled in 1,015 public and private high schools across the country participated in the Base Year survey.
>
> Several special strata were included in the sample with probabilities higher than their occurrence in the population to allow for study of certain types of schools or students. These include:

Hispanic strata, with probabilities of selection to secure sufficient numbers of Cuban, Puerto Rican and Mexican students for separate analysis.

. . .

Survey instruments in the Base Year included:

A school questionnaire

Student identification pages

A sophomore questionnaire

A senior questionnaire

A series of cognitive tests for each cohort

Teacher comment checklist

Parent questionnaires (mailed to a sample of parents from both cohorts)

The student questionnaires focused on individual and family background, high school experiences, work experiences, and plans for the future. Cognitive tests administered to students measured both verbal and quantitative abilities. In addition, sophomore tests included achievement measures in science, writing, and civics, while seniors were asked to respond to tests measuring abstract and nonverbal abilities. . . . (Educational Testing Service, located in Princeton, New Jersey, developed the cognitive tests for the High School and Beyond data base. Reliability quotients were considered to be in acceptable ranges and are discussed by Heynes and Hilton (1982).)

Sophomore Test (p 10):

The sophomore test covered the following areas:

1. Vocabulary (21 items, 7 minutes). A brief test using synonym format.

2. Reading (20 items, 15 minutes). A test based on short passages (100-200 words) with several related questions concerning a variety of reading skills (analysis and interpretation) but focusing on straightforward comprehension.

3. Mathematics (38 items, 21 minutes). Quantitative comparisons in which the student indicates which of two quantities is greater, or asserts their equality, the lack of sufficient data to determine which quantity is greater. . . .

Math, part I consists of arithmetic computation.

Math, part II consists of algebra, geometry and problem solving.

The variable LANGSD is an average of vocabulary and reading scores.

The variable MATHSD is an average of math, part I and math, part II scores.

The variable BYTEST is an average of vocabulary, reading, and math, part I scores.

Base Year Data Collection (pp 40-41):

Base Year student data was collected from students in 1,015 high schools between February 1 and May 15 of 1980. Sophomore and senior groups within each school were gathered in separate groups on scheduled survey days and completed the questionnaires and tests in one session. A NORC (National Opinion Research Center) Survey Representative (often assisted by school coordinator) was present with each group to explain survey procedures and to answer questions. An Orientation Day was held in each school, usually two weeks prior to the Survey Day, in order to inform sample students about the objectives of the study and to brief them on the requirements of participation, the voluntary nature of the study, and the procedures for protecting the confidentiality of their responses. . . . Finally, a check was made during the orientation to see that parental permission forms had been obtained for all selected students in each school or district where this step was required.

The first step for students in each survey session was to complete a Student Identification Pages booklet, which requested information about how the student might be located if selected for future follow-up. To preserve student confidentiality, these documents were handled, shipped, and stored separately from all other student instruments. The later section of the Student Identification Pages booklet contained several questions designed to identify students who had been exposed to non-English languages outside of formal school courses. Students having such exposure then answered a special series of questions about their use of and proficiency in the non-English language, as well as their bilingual education experiences. This data was processed into a separate file containing responses from over 11,300 students.

Students were given one hour to complete the questionnaires. During this time, Survey Representatives scanned the completed Student Identification Pages booklets for missing or incomplete responses. At the end of the allotted time questionnaires were collected. Students were given a ten-minute break, during which the Survey Representatives reviewed the questionnaires for completeness. Further attempts were made to obtain any data missing from either the Student Identification Pages booklets or the student questionnaires before students left the survey session.

The cognitive tests were administered following the completion of the questionnaires. Tests consisted of six timed segments. When the testing was completed, students with incomplete Student Identification Pages booklets or questionnaires were asked to remain so that missing data could be captured. For certain questionnaire items considered crucial to the analytical objectives of the study, students were given the option of marking a special oval in the question field indication that they did not wish to answer.

> Following the survey session, NORC Survey Representatives made arrangements with School Coordinators to conduct make-up sessions for students who were not able to attend the first Survey Day. Survey Representatives then packaged all completed student questionnaire and test booklets for shipment to NORC's optical scanning subcontractor for conversion of student responses to machine-readable form. Student Identification Pages, parental permission forms (if any), and administrative documents were returned to NORC's central offices for processing and storage. . . . (Of the 35,723 1980 sophomores selected, 30,030 i.e. 84%, completed the student questionnaire and 27,569, i.e. 77%, completed the tests.)

III. Preparation of Data Set for the Current Study of Mexican-American Sophomores

During the late 1960's and early to middle 1970's the cohort under study was in the elementary grades. The primary purpose of this study is to assess the impact of special language programs taken during the late 1960's and early 1970's on the later academic achievement of Mexican-American sophomores. All Mexican-American students in the selected subsample spoke Spanish as a first language in the home and were educated entirely in the United States. In assessing the role of special language programs, educational background factors such as participation in various types of bilingual education programs will be analyzed and correlated with later educational achievement, while taking into consideration socioeconomic status, parental educational level, home language, type of bilingual program, immigration history, sex of the respondent and other factors (Lambert, Gardner, Olton & Turnstall, 1970; Sewell, Haller & Portes, 1969; Skutnabb-Kangas, 1980). Academic achievement will be measured through three High School and Beyond standardized tests, administered to the 1980 sophomore cohort: English comprehension, vocabulary, and mathematics (parts I and II).

The 1980 sophomore cohort was selected for analysis because this group was one of the early recipients of bilingual education in the United States. Different types of bilingual programs were available for limited English proficient students: content instruction in the home language, reading and writing instruction in home language, and English as a second language. Some of these programs included study of the cultural history of the student.

The General Information File (GINF 82), containing information about the sophomore cohort's education, post-secondary educational plans, demographics and values was used for the current study (N=30,000). From this file, Mexican-American sophomores were then selected (N=1162 with 35 variables.) The subfile was titled GINF MEX-AM SOPH. This file was merged with the Language File, which contains language usage information and self-reported information about bilingual education experiences for students who speak non-English languages (N=11,000 with 40 variables.) Merging was accomplished through the use of precoded, randomized identification numbers assigned to each student. This yielded a total of 74 variables from both General Information and Language files (N=1162). From this group, a final selection criterion was introduced: the use of Spanish as a first language before entering elementary school. Within this group, some students spoke exclusively Spanish (Span-Only group) and others spoke Spanish and English (Span-Eng group). These two categories were analyzed separately in the present study. A flowchart for the data set preparation is shown in figure 1.

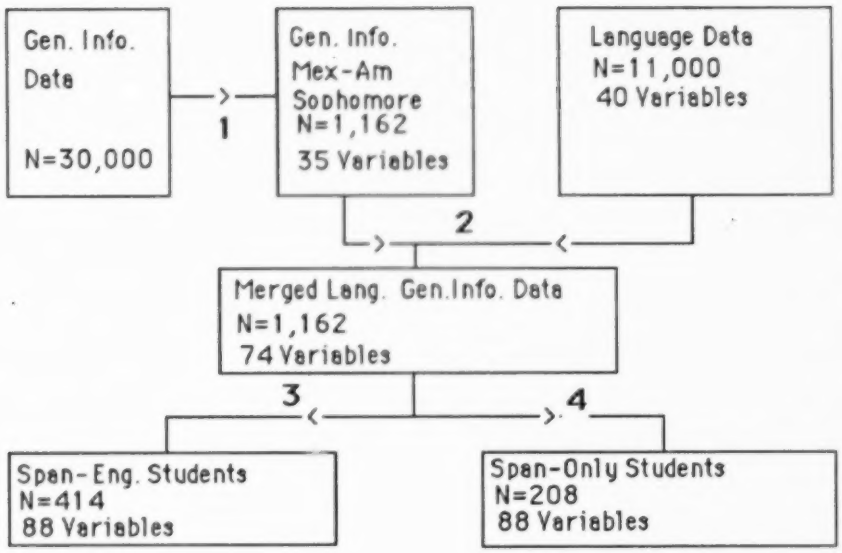

FIGURE 1. Flowchart for the preparation of Spanish-English and Spanish-Only data sets. The four stages are numbered. Stage **1**: Selection of Mexican-American sophomores, (HS&B coding of variables: RACE=1,BB090=1, GRADE=1, LANGDATA=1 and TESTDATA=1.) Stage **2**: Merging general information and language data by ID. Stage **3** : Selection of Spanish-English group (Language file coding of variables: LB11=2 and LB12=2.) Stage **4** : Selection of Spanish-only group (LB11=2 and LB12=1.) New composite variables are defined in stages 3 and 4.

The first subset contains 414 Mexican-American sophomores who spoke *Spanish as a first language and some English* (Span-Eng group) before entering school and who were educated entirely in the United States. This group was exposed to differing educational programs during the elementary years. Programs included English as a second language (ESL), reading and writing in Spanish, other subjects taught in Spanish and cultural history of the student. These programs sometimes existed with a single educational treatment variable, for example, only ESL, and at other times with combinations of variables, for example, ESL, reading and writing in Spanish and a cultural history component. Some of the students in this group received no special educational treatment. A breakdown of all combinations of educational treatments and the number of students in each treatment group is given in table 1. Initial observation of this group took into account 88 educational and background factors. Composite variables were defined from the initial 88 variables, thus reducing the number of variables to 60. These variables, used in the present study, are listed in the appendix.

TABLE 1

BREAKDOWN OF SPANISH-ENGLISH GROUP INTO ALL POSSIBLE PROGRAMS

N = Number of students in the program. Y=Yes, N=No
Each of the programs is given a number under the variable BGRPS.
A dot (.) represents missing value

BGRPS	ESL	READ/WRITE	OTH. SUBJ.	CULT.	N
0	N	N	N	N	138
1	Y	N	N	N	8
2	N	Y	N	N	33
3	N	N	Y	N	6
4	N	N	N	Y	54
5	Y	Y	N	N	13
6	Y	N	Y	N	0
7	Y	N	N	Y	10
8	N	Y	Y	N	7
9	N	Y	N	Y	27
10	N	N	Y	Y	7
11	Y	Y	Y	N	10
12	Y	Y	N	Y	10
13	Y	N	Y	Y	4
14	N	Y	Y	Y	21
15	Y	Y	Y	Y	38
.	.	.	.	.	28

IV. Hierarchical Component Analysis of the Spanish-English Treatment Group

The current study will focus on the internal dynamics of bilingual programs. Only the treatment groups will be assessed, with the objective of clarifying the long-term academic impact of four bilingual program components: English as a second language, reading and writing in Spanish, other subjects taught in Spanish and ancestral/ cultural history. All possible combinations of these components will be considered for the current

study. In contrast to most of the earlier studies which looked upon bilingual programs as a whole, the current study focuses on bilingual programs in terms of the above four components. In addition, 37 background factors were observed to ensure that the observed academic effects were, in fact, due to bilingual programs.

A bilingual *program* consists of one or more of the following educational components: ESL , reading and writing in Spanish, other subjects taught in Spanish and ancestral/cultural history. For convenience, these educational programs will be referred to as the following:

A =ESL

B=Reading and writing in Spanish

C=Other subjects taught in Spanish

D=Ancestral/cultural history

The presence or absence of a component within each possible bilingual program is tabulated hierarchically. This tabulation is schematically represented in figure 2.

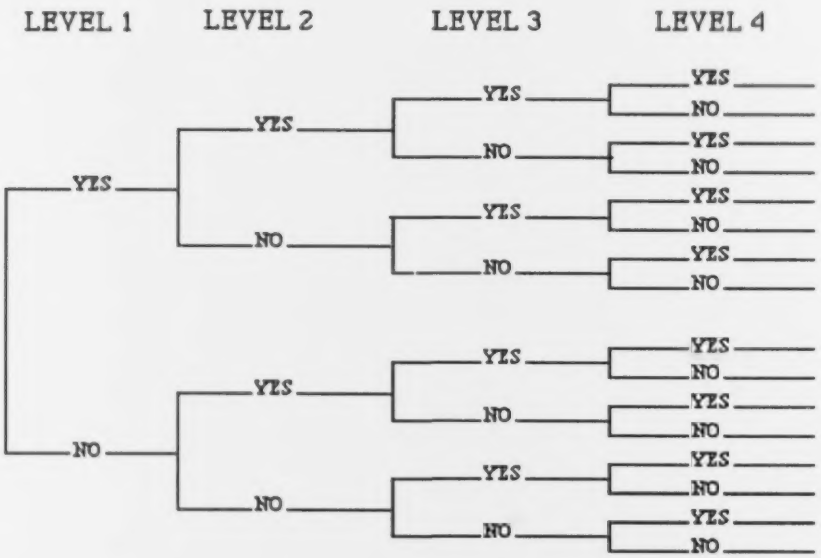

FIGURE 2 Schematic diagram showing all possible programs through hierarchical sorting in terms of presence (yes) or absence (no) of components.

A particular example, following this general scheme, with "Hierarchy CDAB" is shown in figure 3. Each possible program is identified with a number under the variable BGRPS. Thus, BGRPS=5 corresponds to the program that contains A and B but not C or D.

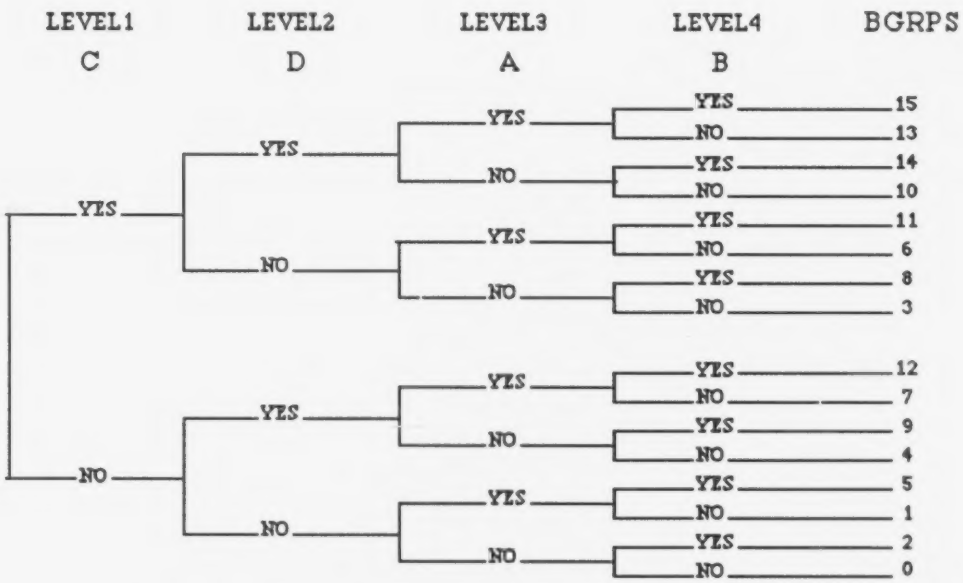

FIGURE 3 A particular example of hierarchical sorting of programs. Here components C, D, A, and B on levels 1 through 4 respectively. Each of the 16 possible programs is numbered 0-15 under the variable BGRPS.
A=ESL, B=Reading and writing in Spanish, C=Other subjects taught in Spanish and D=Ancestral/cultural history

In the above scheme, the effect of a component, at various levels, may be analyzed. For example, on level 1, a program that includes component C can be compared with a corresponding program that excludes component C. There will be 8 such pairs in which the effects of C may be assessed; in each of these pairs, a program that contains C is compared with an identical program that does not contain C.

However, since we have removed the no-treatment group from the current study, 7 pairs remain. Thus, the emergent pairs in this example are:

BGRPS = 15 and BGRPS = 12

BGRPS = 13 and BGRPS = 7

BGRPS = 14 and BGRPS = 9

BGRPS = 10 and BGRPS = 4

BGRPS = 11 and BGRPS = 5

BGRPS = 6 and BGRPS = 1

BGRPS = 8 and BGRPS = 2

Similarly, comparisons of corresponding programs can be made on the second level. In the above example, within th the programs which do not contain the component C (C=NO branch in figure 3) the programs which contain D can be compared with the corresponding programs which do not contain D, pairwise. Thus, within all the programs which contain C, the following pairs for D on the second level emerge:

BGRPS = 12 and BGRPS = 5

BGRPS = 7 and BGRPS = 1

BGRPS = 9 and BGRPS = 2

The same type of pairing emerges for D on the second level, for programs that do contain the component C (C=YES branch in figure 3). These pairs are:

BGRPS = 15 and BGRPS = 11

BGRPS = 13 and BGRPS = 6

BGRPS = 14 and BGRPS = 8

BGRPS = 10 and BGRPS = 3

It should be noted that if a strong trend appears when this component is placed on the first level, clearly the same trend will appear when this component is placed on the second or higher level. The trends that will be looked for in this study will be the systematic raising or lowering of achievement test scores when a component is added to the program. If a systematic trend is not perceived on the first level, then a second-level trend will be sought. This will be done by matching pairs on the second level and again looking for trends. If a trend is found on the second level but not the first level, an interactive effect is implied. These features will be explained in greater detail in the analysis that follows.

In principle, this type of hierarchical sorting and comparison can be performed on levels 3 and 4, also. In this study, trends for the academic impact of the components emerge on the first and second levels. However, on the third and fourth levels the number of pairs available for comparison are too few to clearly ascertain such trends. As a first step, the hierarchical component analysis will be used to assess long-term effects of bilingual programs. Long-term academic effects of elementary-level bilingual programs are measured through standardized tests taken by the treatment groups during their sophomore year of high school. This study will use the variable BYTEST to measure academic achievement. BYTEST is a composite test score, the mean of English vocabulary, English reading and math (part I) test scores, as described above.

The results of putting each component on the first level follow.

Hierarchical Component Analysis with Component A, ESL, on the First Level:

Hierarchical sorting was performed with the hierarchy A, C, D, B on the first through fourth levels respectively. Table 2 illustrates this hierarchical sorting for the Spanish-English group. As described above, a pairwise comparison may be made between otherwise identical programs with and without the presence of component A. For example,

in table 2 program BGRPS = 15 can be compared with with program BGRPS = 14. Similarly, BGRPS = 13 is compared with BGRPS = 10, and so on. There are 8 such pairs. However, the program BGRPS = 6 contains no students in the Spanish-English group. Thus, one of the possible pairs is unavailable for analysis. In addition, since the no-treatment group has been excluded from the current study, 6 pairs remain for analysis.

For the 6 pairs remaining, in all but one program, the addition of component A is associated with *lowered* BYTEST scores.

TABLE 2

HIERARCHY ACDB: SPANISH-ENGLISH GROUP

The superscripts on the BYTEST scores identify pairs of programs that are compared. A=ESL, B=Reading and writing in Spanish, C=Other subjects taught in Spanish and D=Ancestral/cultural history. The presence or absence of a component is indicated by Y (yes) and N (no) respectively. A dot (.) represents missing value.

N	BGRPS	A	C	D	B	BYTEST	LANGSD	MATHSD
28	.	.	.	.	.	43.4	43.4	43.4
38	15	Y	Y	Y	Y	40.9 [1]	41.2	40.9
4	13	Y	Y	Y	N	37.3 [2]	37.1	37.1
10	11	Y	Y	N	Y	40.5 [3]	40.3	40.8
0	6	Y	Y	N	N	. [4]	.	.
10	12	Y	N	Y	Y	44.7 [5]	45.7	46.6
10	7	Y	N	Y	N	42.5 [6]	41.8	45.3
13	5	Y	N	N	Y	44.5 [7]	44.7	46.0
8	1	Y	N	N	N	41.8 [8]	42.4	41.6
21	14	N	Y	Y	Y	43.7 [1]	43.6	45.3
7	10	N	Y	Y	N	44.2 [2]	44.5	44.2
7	8	N	Y	N	Y	42.8 [3]	43.4	44.8
6	3	N	Y	N	N	39.9 [4]	40.2	38.6
27	9	N	N	Y	Y	44.5 [5]	43.2	46.4
54	4	N	N	Y	N	46.4 [6]	46.1	47.7
33	2	N	N	N	Y	45.1 [7]	44.8	47.0
138	0	N	N	N	N	46.2 [8]	45.9	46.6

Hierarchical Component Analysis with Component B, Reading and Writing in Spanish, on the First Level:

Hierarchical sorting with component B on the first level is illustrated in table 3. Due to the reasons explained above, 6 pairs are available for analysis. As can be seen in

table 3, in 4 out of 6 pairs the presence of component B is associated with *raised* BYTEST scores. As this is not as strong a trend as was observed in the previous case, hierarchical sorting with B on the second level will be performed below.

TABLE 3

HIERARCHY BADC: SPANISH-ENGLISH GROUP

A=ESL, B=Reading and writing in Spanish, C=Other subjects taught in Spanish and D=Ancestral/cultural history. The presence or absence of a component is indicated by Y (yes) and N (no) respectively. A dot (.) represents missing value.

N	BGRPS	B	A	D	C	BYTEST	LANGSD	MATHSD
28	.	.	.	.	.	43.4	43.4	43.4
38	15	Y	Y	Y	Y	40.9	41.2	40.9
10	12	Y	Y	Y	N	44.7	45.7	46.6
10	11	Y	Y	N	Y	40.5	40.3	40.8
13	5	Y	Y	N	N	44.5	44.7	46.0
21	14	Y	N	Y	Y	43.7	43.6	45.3
27	9	Y	N	Y	N	44.5	43.2	46.4
7	8	Y	N	N	Y	42.8	43.4	44.8
33	2	Y	N	N	N	45.1	44.8	47.0
4	13	N	Y	Y	Y	37.3	37.1	37.1
10	7	N	Y	Y	N	42.5	41.8	45.3
0	6	N	Y	N	Y	.	.	.
8	1	N	Y	N	N	41.8	42.4	41.6
7	10	N	N	Y	Y	44.2	44.5	44.2
54	4	N	N	Y	N	46.4	46.1	47.7
6	3	N	N	N	Y	39.9	40.2	38.6
138	0	N	N	N	N	46.2	45.9	46.6

Hierarchical Component Analysis with Component C, Other Subjects Taught in Spanish, on the First Level:

Table 4 illustrates hierarchical sorting with component C on the first level. In this case, a strong trend emerges. In all the pairs, the presence of component C is associated with *lowered* BYTEST scores.

TABLE 4

HIERARCHY CDAB: SPANISH-ENGLISH GROUP

A=ESL, B=Reading and writing in Spanish, C=Other subjects taught in Spanish and D=Ancestral/cultural history. The presence or absence of a component is indicated by Y (yes) and N (no) respectively. A dot (.) represents missing value.

N	BGRPS	C	D	A	B	BYTEST	LANGSD	MATHSD
28	.	.	.	.	.	43.4	43.4	43.4
38	15	Y	Y	Y	Y	40.9	41.2	40.9
4	13	Y	Y	Y	N	37.3	37.1	37.1
21	14	Y	Y	N	Y	43.7	43.6	45.3
7	10	Y	Y	N	N	44.2	44.5	44.2
10	11	Y	N	Y	Y	40.5	40.3	40.8
0	6	Y	N	Y	N	.	.	.
7	8	Y	N	N	Y	42.8	43.4	44.8
6	3	Y	N	N	N	39.9	40.2	38.6
10	12	N	Y	Y	Y	44.7	45.7	46.6
10	7	N	Y	Y	N	42.5	41.8	45.3
27	9	N	Y	N	Y	44.5	43.2	46.4
54	4	N	Y	N	N	46.4	46.1	47.7
13	5	N	N	Y	Y	44.5	44.7	46
8	1	N	N	Y	N	41.8	42.4	41.6
33	2	N	N	N	Y	45.1	44.8	47
138	0	N	N	N	N	46.2	45.9	46.6

Hierarchical Component Analysis with Component D, Ancestral/Cultural History, on the First Level:

The trend which emerges with D on the first level can be seen in table 5. In 5 out of 6 pairs, the presence of component D is associated with *raised* BYTEST scores.

TABLE 5

HIERARCHY DABC: SPANISH-ENGLISH GROUP

A=ESL, B=Reading and writing in Spanish, C=Other subjects taught in Spanish and D=Ancestral/cultural history. The presence or absence of a component is indicated by Y (yes) and N (no) respectively. A dot (.) represents missing value.

N	BGRPS	D	A	B	C	BYTEST	LANGSD	MATHSD
28	.	.	.	.	.	43.4	43.4	43.4
38	15	Y	Y	Y	Y	40.9	41.2	40.9
10	12	Y	Y	Y	N	44.7	45.7	46.6
4	13	Y	Y	N	Y	37.3	37.1	37.1
10	7	Y	Y	N	N	42.5	41.8	45.3
21	14	Y	N	Y	Y	43.7	43.6	45.3
27	9	Y	N	Y	N	44.5	43.2	46.4
7	10	Y	N	N	Y	44.2	44.5	44.2
54	4	Y	N	N	N	46.4	46.1	47.7
10	11	N	Y	Y	Y	40.5	40.3	40.8
13	5	N	Y	Y	N	44.5	44.7	46
0	6	N	Y	N	Y	.	.	.
8	1	N	Y	N	N	41.8	42.4	41.6
7	8	N	N	Y	Y	42.8	43.4	44.8
33	2	N	N	Y	N	45.1	44.8	47
6	3	N	N	N	Y	39.9	40.2	38.6
138	0	N	N	N	N	46.2	45.9	46.6

Hierarchical Component Analysis with Component B, Reading and Writing in Spanish, on the Second Level:

As was mentioned earlier, a hierarchical component analysis was performed with component B on the second level. On the first level, components A, C, and D were tried, always maintaining component B on the second level. Only in the case of component A on the first level did a clear BYTEST achievement trend emerge for component B. Table 6 illustrates this trend.

In all programs where A is present, the addition of B is associated with *raised* BYTEST scores. In all programs in which the addition of B is associated with *lowered* BYTEST scores, component A was absent. The possibility of an interactive effect between components A and B is thus implied.

TABLE 6

HIERARCHY ABDC: SPANISH-ENGLISH GROUP

A=ESL, B=Reading and writing in Spanish, C=Other subjects taught in Spanish and D=Ancestral/cultural history. The presence or absence of a component is indicated by Y (yes) and N (no) respectively. A dot (.) represents missing value.

N	BGRPS	A	B	C	D	BYTEST	LANGSD	MATHSD
28	.	.	.	.	.	43.4	43.4	43.4
8	15	Y	Y	Y	Y	40.9	41.2	40.9
10	11	Y	Y	Y	N	40.5	40.3	40.8
10	12	Y	Y	N	Y	44.7	45.7	46.6
13	5	Y	Y	N	N	44.5	44.7	46
4	13	Y	N	Y	Y	37.3	37.1	37.1
0	6	Y	N	Y	N	.	.	.
10	7	Y	N	N	Y	42.5	41.8	45.3
8	1	Y	N	N	N	41.8	42.4	41.6
21	14	N	Y	Y	Y	43.7	43.6	45.3
7	8	N	Y	Y	N	42.8	43.4	44.8
27	9	N	Y	N	Y	44.5	43.2	46.4
33	2	N	Y	N	N	45.1	44.8	47
7	10	N	N	Y	Y	44.2	44.5	44.2
6	3	N	N	Y	N	39.9	40.2	38.6
54	4	N	N	N	Y	46.4	46.1	47.7
138	0	N	N	N	N	46.2	45.9	46.6

Summary of Trends Obtained Through the Hierarchical Component Analysis of the Spanish-English Group:

Results of the above analyses indicate that C is consistently associated with decreased scores. In 5 out of 6 pairs, A is associated with decreased scores. D is

associated with increased scores in 5 out of 6 pairs. Inconsistent effects of B on the first level are clarified when the interaction of A and B are observed, with B on the second level. When A is present in a program, the addition of B is consistently associated with raised scores; when A is not present, the addition of B is associated with decreased scores. No similar pattern is discerned when either C or D are placed on the first level, maintaining B on the second level.

It is important to note that the above analyses reveal trends in academic achievement and their association with components of bilingual education programs. These trends by themselves do not prove causal relationships, however. Rather, they point to areas which may be further explored through more traditional statistical analyses. Whenever trends were found, t-tests, ANOVA and step-wise regression analysis were performed (Olson, 1987). These analyses demonstrated that among all of the components, component C is a strong predictor of lowered BYTEST scores. The lowering of scores associated with C could not be attributed to factors such as parental educational expectations, students' educational aspirations, socioeconomic status or any of the numerous factors listed in the appendix (Olson, 1987).

The positive effects of component D, mentioned above, did not reach statistical significance in a t test. However, if the the increase and decrease of scores was nominalized (with +1 indicating an increase and -1 indicating a decrease) the systematic increase associated with D in the hierarchical component analysis became statistically significant at the .05 level.

From the above results, it is clear that different program components are associated with differing long-term academic achievement scores. Hierarchical component analysis aids in the clarification of these trends and may help to explain discrepant research finding from previous studies of bilingual programs. The strength of hierarchical component analysis lies in its ability to distinguish between different types of bilingual education programs; it provides a systematic way of comparing programs with several components.

If one were simply to compare in pairs all possible programs with four components, 120 pairwise comparisons would be necessary. Even if all 120 comparisons were performed, these isolated comparisons would not readily yield a perspective which would clarify trends in the data. Most previous studies have not distinguished with such detail the internal components of bilingual education programs.

Summary of Trends which have Emerged Through the Hierarchical Component Analysis of the Spanish-Only Group:

Results of analyses (Olson, 1987) show trends in the Spanish-only group (students who spoke only Spanish before entering school) which are similar to trends found in the Spanish-English group. Component A, ESL, emerged with mixed effects for the Spanish-only group; the same component is more strongly associated with lowered achievement scores for the Spanish-English group. Reading and writing in Spanish, component B, is associated with a tendency toward raised BYTEST scores for both Spanish-only and Spanish-English students. Component C, other subjects taught in Spanish, shows a marked association with lower BYTEST achievement scores for both Spanish-only and Spanish-English students. Component D, cultural/ancestral history, is associated with raised achievement scores for both groups, however, a stronger effect appears in the Spanish-English programs.

As in the case of the Spanish-English group, further analysis was performed for the Spanish-only group. Statistical significance at the .05 level was achieved only for the component C when t tests were performed. For the components A, B, and D the lack of statistical significance at the .05 level once again points to the need for replication studies with larger sample sizes to further investigate the positive effects of B and D and the ambiguous effects of A. Detailed results may be found in Olson, 1987.

V. Conclusions and Implications for Research

Hierarchical component analysis was developed for the purpose of this study to see if a systematic ordering would emerge with the addition of any given component to all possible programs. It was discovered that trends did emerge.

The current study is limited by the fact that of the 30,723 1980 sophomores initially selected for the High School and Beyond study, 30,030, i.e. 84%, completed the student questionnaire and 27,569, i.e. 77% completed the cognitive tests. Thus, absent students are not included in the analysis. In addition, high school dropouts are not included in the current analysis. All background information, including early participation in bilingual education programs, is self-reported. In addition, no elementary-level pretest scores were available, making relative achievement gains impossible to assess. Student placement in bilingual education programs was not random. Willig (1985) suggests that due to the transitional nature of most bilingual education programs in the United States and the fact that LEP students are usually placed in all-English classes as soon as possible, some students who are linguistically gifted and/or high academic achievers may not have been placed in bilingual programs. In addition, sociolinguistic factors may differ between students who are placed in bilingual programs and those who are not. In the current study, sociolinguistic factors were found to be significantly different (.05 level) at the 1980 time point. No measurement data was available for the earlier years. Due to the above factors, Willig (1985) suggests that LEP students who were not placed in bilingual programs should not be used as a control group. In the current study, no-treatment students were not considered to be a control group.

There is a strong indication from the present study that elementary school bilingual education programs are associated with a long-term effect on academic achievement. Additionally, students who have participated in bilingual education programs demonstrate

significantly different sociolinguistic background factors (.05 level) from students who have not participated in special language programs. Parental educational expectations for the student, student educational expectations and SES do not vary significantly.

There is a clear indication that varying components of bilingual education programs are associated with differential effects on long-term achievement. This study looked at bilingual programs in terms of the following four components:

A. English as a second language

B. Reading and writing in Spanish

C. Other subjects taught in Spanish

D. Cultural/ancestral history

For purposes of this study, a bilingual program was defined as a special educational treatment containing one or more of the above four components. 16 possible combinations were defined. Program pairs were were then extracted; three of the four components were held constant in each pair with only the fourth left free to vary. Hierarchical component analysis, developed for purposes of this study, was then performed.

A hierarchical component analysis of the effects of the four components on academic achievement, as measured by English reading, vocabulary and mathematics tests (variable BYTEST), administered during the sophomore year of high school revealed the following trends :

Participation in programs containing the component English as a second language was associated with mixed effects. For certain bilingual education programs the addition of ESL was associated with increased long-term achievement scores; for other programs it was associated with lowered scores.

1. For the Spanish-English group, the addition of ESL to a program was associated with decreased achievement scores in 5 out of 6 programs pairs. ESL

had a positive interactive effect when present in a program containing reading and writing in Spanish, however.

2. For the Spanish-only group, the addition of ESL to a program was associated with an increase in achievement scores in 3 out of 6 programs. ESL demonstrated a positive interactive effect when present in a program containing other subjects taught in Spanish.

Troike (1976) suggests that pull-out ESL classes may stigmatize students both from their own point of view and from the point of view of their peers. While out of the classroom, these students are deprived of regular curricular activities, thus reducing opportunities for cognitive development. Additionally, inappropriate methodologies such as empty pattern practice drills and ethnocentric pronunciation drills would be likely to hinder the achievement of ESL students. These factors may particularly help to explain the pronounced negative effect of ESL instruction on students who spoke Spanish as a first language and some English before entering school. Troike (1976) cites evidence that a language is learned best when it is taught as a medium of communication of content rather than as an object and end in itself. Methodologically appropriate ESL instruction, however, may have a positive impact in the bilingual classroom.

Instruction in reading and writing in Spanish tends to have a positive impact on long-term academic achievement.

1. For the Spanish-English group, the addition of reading and writing in Spanish to a program was associated with an increase in achievement scores in 4 out of 6 program pairs. In programs in which ESL was present, reading and writing in Spanish was consistently associated with raised test scores; when ESL was absent, reading and writing in Spanish was associated with a lowering of scores.

2. For the Spanish-only group, the addition of reading and writing in Spanish to a bilingual program was associated with an increase in test scores in 4 out of 6 pairs.

Mace-Matluck et al. (1986) state that children who come to school with well developed oral language skills in either or both languages have an advantage in learning to read connected text. Oral language skills were shown to be substantially related to reading comprehension. Mace-Matluck's (1986) findings further support the premise that reading is a single process and that reading skills developed in one language do transfer, if proper conditions are met, to successful reading in a second language. Initial reading instruction in the stronger language of the child appears to benefit the child. Other researchers (Moll, Díaz, Estrada, & Lopes, 1981) point out that learning is often specific to situation and that the learning environment needs to provide an environment where the applicability of previously learned material will be clearly related to the student. This is particularly true in the case of transfer of Spanish reading and writing skills to English reading and writing and vice versa. Inconsistent methodologies and strategies may be partially underlying the nonuniform positive effects of reading and writing instruction in Spanish reported above.

The teaching of other subjects such as mathematics and science in Spanish was clearly associated with a lowering of test scores.

1. For the Spanish-English group, the addition of other subjects taught in Spanish to a bilingual program was associated with lowered scores in all 6 bilingual program pairs.
2. For the Spanish-only group, the addition of other subjects taught in Spanish to a bilingual program was associated with lowered scores in 6 out of 7 program pairs. The one program sample that did not contain other subjects taught in Spanish and yet had lower scores consisted of only four students with extremely

low SES, educational aspirations and parental educational expectation. ESL demonstrated a positive interactive effect when present in programs containing other subjects taught in Spanish.

The Significant Bilingual Instruction Features Study (Tikunoff, 1982) found that teachers in academically successful bilingual classrooms spent fully 75% of the school day on basic skills instruction. Reading and language arts accounted for slightly over half of the school day, mathematics accounted for approximately 20% of the day, and other subjects combined accounted for about 25% of the day. In addition, instructional features such as the specific way in which the teacher delivered content instruction were shown to be important to achievement. These factors were unavailable for analysis in the current study; these differences may help to account for differences in long-term achievement.

SRA Technologies is currently conducting a Department of Education funded study of bilingual education programs (Crawford, 1986). The study is finding that students in bilingual education programs with greater native-language components perform considerably better on achievement tests in reading, language arts and mathematics. It should be noted that the current study relies on self-reported data and is measuring long-term effects of bilingual programs which were in place during the late 1960's and early to middle 1970's. At that time, Spanish-language materials and books in content areas were only beginning to become available for use in the bilingual classroom.

Ancestral/cultural history showed a positive trend when added to bilingual education programs.

1. For the Spanish-English group, the addition of ancestral/cultural history is associated with raised scores in 5 out of 6 pairs.
2. For the Spanish-only group, the addition of ancestral/cultural history is associated with raised scores in 4 out of 6 pairs.

Cummins (1982, 1986) suggests that students whose culture is validated both within and outside the classroom tend to perform better in academic subjects. He further suggests that fundamental relationships between educators and minority students and between schools and communities must be significantly altered in order to empower students and thereby lead to educational success. Cultural/ancestral history, sensitively taught by a knowledgeable teacher may validate a child's heritage. It is noteworthy that the addition of cultural history to a no-treatment group was associated with an increase in academic achievement scores. Similarly, cultural history tends to have a beneficial effect when added to programs having other bilingual education components.

t tests were conducted to determine whether observed differences in achievement scores (variable BYTEST) associated with the four components were statistically significant (.05 level). Statistical significance was reached for the Spanish-English group in the cases of English as a second language and other subjects taught in Spanish. For the Spanish-only group, statistical significance was reached only in the case of other subjects taught in Spanish.

When a difference was found to be statistically significant, an extensive set of t tests were performed to see if the observed effects could be attributed to background variables. Stepwise multiple regression identified background variables important to educational achievement: student educational aspirations, parental educational expectations, and language use in the community. From the t tests it was found that none of the effects could be attributed to factors such as socioeconomic status, educational aspirations or parental educational expectations, factors which the literature (Sewell, Haller & Portes, 1969; Sewell, Haller & Ohlendorf, 1970; Alexander, Ekland & Griffin, 1981; Blau & Duncan, 1967; Elder, 1968; Hauser, 1972) suggested as important. Significant differences were only found in current language usage patterns with students who studied other

subjects in Spanish using their Spanish more in home and community interaction. This, however, is in the context of a general shift toward English language usage. It should be noted that this study controlled for language factors upon entering school, grouping students who spoke only Spanish separately form those who spoke Spanish as a first language and some English.

Analysis of variance further clarified direct effects of individual bilingual program components as well as interactive effects among the components. For both the Spanish-English and Spanish-only groups, ESL was associated with positive interactive effects. For the Spanish-English group, interactive effects found through hierarchical component analysis between ESL and reading and writing in Spanish were also found in the ANOVA. Reading and writing in Spanish was associated with raised achievement when ESL was present. The level of significance for this interactive effect was .079 when the no-treatment group was included and was .013 when the no-treatment group was excluded. For the Spanish-only group, analysis of variance showed an interactive effect between ESL and other subjects taught in Spanish. The presence of ESL had a positive effect on achievement when included in a program which also contained other subjects taught in Spanish. This interaction was significant at the .04 level. All of the direct effects of the individual bilingual programs found in the hierarchical component analysis and the t tests were in concurrence with the results of ANOVA.

It was mentioned above that cultural history tends to have a beneficial effect on academic achievement in most of the programs. Andersson and Boyer (1978) and Walker (1978) emphasize the close connections among language, culture and affective factors influencing self-image and academic achievement. Although the presence of cultural history in a bilingual program was associated with raised academic achievement, neither the t tests nor ANOVA showed this effect to be statistically significant. This could be due to weighting each program by sample size. Statistical significance can, indeed, be reached for this component if the effect of adding cultural history to each bilingual program is

nominalized (positive effect assigned a +1 and negative effect assigned a -1) and the no-treatment group included.

The above findings concerning the differential effects of bilingual education program components may help to explain some of the discrepancies evident in the literature on program evaluation (Troike, 1978; Dulay and Burt, 1978; Engle, 1975) . Bilingual education programs measured during the late 1960's and early to middle 1970's which were associated with positive results may have been, at least in part, measuring the beneficial effects of reading and writing in Spanish, cultural/ancestral history and English as a second language when appropriately administered to students. Programs showing negative results may have been assessing the effects of other subjects taught in Spanish during this time period and ESL inappropriately administered to students. The fact that different program components are associated with different achievement gains clearly points to the advantages of component analysis if the internal dynamics of bilingual education programs are to be clearly understood.

Future research in bilingual education must account for program variation if comparisons across differing programs are to be adequately made. Assessing bilingual education programs in terms of four components: English as a second language, reading and writing in Spanish, other subjects taught in Spanish and ancestral/cultural history may prove to be a useful model for uniform assessment of the curricular aspects of bilingual education programs. Hierarchical component analysis was developed to provide a manageable way of analyzing the various program components in an organized and understandable fashion.

The current study has assessed the long-term academic effects associated with bilingual education components during the late 1960's and early to middle 1970's. A decade has passed since that time. It is suggested that replication studies be done assessing elementary-level bilingual education programs in place during the 1980's to

document the possibly shifting impact of program components. It is hoped that the methodology of this study may prove useful to future researchers concerned with such assessment.

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Appendix

Variables used in the current study

Variables were chosen from the General Information file and Language file. The following variables were selected for the final data analysis:

General Information File Variables:
Variable names used for statistical analysis are in parentheses

1. Student identification number (ID)

2. Sex (SEX)

3. Race (RACE)
   Response to the question, "What is the respondent's race?". Only students whose response was "Hispanic or Spanish" were selected for the current study.

4. Origin or descent (BB090)
   Response to the question, "What is your origin or descent?". Only those whose response was "Mexican, Mexican-American, Chicano" were selected for the current study.

5. Base year test composite (BYTEST)
   Mean of English vocabulary, English reading and math, part I, test scores.

6. Base Year SES Composite (BYSES)
   The socioeconomic scale is constructed from the following five components: father's occupation, (recoded into the Duncan SEI scale), father's education, mother's education, family income, and eight household-possession items.

7. Self concept composite scale score (FYCONCPT)
   A composite score obtained from responses to the following:
   I take a positive attitude toward myself
   I feel I am a person of worth on equal plain with others.
   I am able to do things as well as most other people.
   On the whole I am satisfied with myself.

8. Grade level (GRADE)

9. High school program (BB023)

10. Grades so far in high school (BB007)

11. Absent but not ill (BB016)

12. Years father in US (BB040)

13. Years mother in US (BB043)

14. Respondent born in US (BB044)

15. Years respondent spent in US (BB045)

16. Mother monitors homework (BB046A)

17. Father monitors homework (BB046B)

18. After high school plans-father (BB050A)

19. After high school plans-mother (BB050B)

20. How much schooling do you think that you will get? (BB065)

21. Age (BB084)

22. Sophomore vocabulary standard score (YBVOCSD)

23. Sophomore reading standard score (YBREADSD)

24. Sophomore math, part I, standard score (YBMTH1SD)

25. Sophomore math, part II, standard score (YBMTH2SD)

Variables taken from the Language File:

Variable names used for statistical analysis are in parentheses

26. First language spoken as a child (LB11)
Only those who spoke Spanish as a first language were selected for the current study

27. Other language spoken as a child (LB12)
Those who spoke only Spanish and those who spoke Spanish and some English were grouped separately for the current study.

28. Language usually spoken now (LB13)

29. Language people at home usually speak (LB14)

30. Other language spoken at home (LB15)

31. How well do you understand spoken Spanish? (LB17A)

32. How well do you speak Spanish? (LB17B)

33. How well do you read Spanish? (LB17C)

34. How well do you write Spanish? (LB17D)

35. How often do you speak Spanish to your mother? (LB18A)

36. How often do you speak Spanish to your father? (LB18C)

37. How often do you speak Spanish to friends? (LB18G)

38. How often do you speak Spanish to other students? (LB18H)

39. How often do you speak Spanish in stores? (LB18I)

40. How often do you speak Spanish at work? (LB18J)

41. How often does your mother speak Spanish to you? (LB18B)

42. How often does your father speak Spanish to you? (LB18D)

43. How often do your other relatives speak Spanish to you? (LB18F)

44. How often do your parents speak Spanish to each other? (LB18E)

45. How well do you understand spoken English now? (LB19A)

46. How well do you speak English now? (LB19B)

47. How well do you read English now? (LB19C)

48. How well do you write English now? (LB19D

Bilingual program variables taken from the language file:

Variable names used for statistical analysis are in parentheses

49. Have you taken English for non-English speakers in grades 1-6? (LB20A)

50. Have you taken reading and writing in Spanish in grades 1-6? (LB20B)

51. Have you taken other subjects in Spanish in grades 1-6? (LB20C)

52. Have you taken ancestral and cultural history in grades 1-6? (LB20C)

From the above variables, the following composite variables were constructed for purposes of this study:

Variable names used for statistical analysis are in parentheses

53. Spanish proficiency (SPANPROF)
The total score of items 32-35, above.

54. English proficiency (ENGPROF)
The total score of items 46-49, above.

55. Parents monitor homework (PARMONHW)
The total score of items 14 and 15, above.

56. Mathematics standard score (MATHSD)
Mean of Math, Part I and Part II.

57. Language standard score (LANGSD)
Mean of English reading and vocabulary scores.

58. Educational aspirations (EDASP)
Dichotomized item 18, above. The dichotomization was based on the observation that the frequency distribution was bimodal. (See appendix A)

59. Parental expectations (PAREXP)
Go to college or other

60. Number assigned for each program (BGRPS)
Labeling of all 16 possible combinations of bilingual programs items 49-52, above.

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